SOME NEW RECORDS AND NEW SYNONYMY OF AUSTRALIAN SPECIES OF *ANOPHELES* (DIPTERA, CULICIDAE).

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Records of the distribution of two species, previously unrecorded on the mainland of Australia, are herein presented. These are *Anopheles meraukensis* Venhuis and *Anopheles novaguinensis* Venhuis. Both species were originally described from Dutch New Guinea, the latter as *A. punctulatus* var. *novaguinensis*. We have, however, raised this variety to specific rank.*

Also established is certain new synonymy of *Anopheles annulipes* Walker and *Anopheles novaguinensis* Venhuis.

Anopheles meraukensis Venhuis.

Venhuis, W. G., 1932, *Geneesk. Tijdschr. Ned.-Ind.*, lxxii, 1040.
————, 1932, loc. cit., 1043.
Soesilo, R., and Schoonheyt, L. J., 1932, loc. cit., 1044.

Type locality: Merauke, Dutch New Guinea. Type larva, female and male adults in Section for Malaria Control of the D.V.G. at Batavia-Centrum.

A. meraukensis in Australia.

Credit is due to Dr. G. M. Heydon for first recognizing the existence of a distinct species of *Anopheles* in Cairns in July, 1942. Dr. Heydon later described spontaneously to one of us the distinctive scale pattern of the venter of specimens which were taken in houses in Cairns and which he correctly considered to be distinct from *A. amictus*. Later examination of specimens taken in collections at Cairns at the time of Dr. Heydon's observations revealed definite *A. meraukensis*. The occurrence of *A. meraukensis* in the Northern Territory was first established by the authors early in 1943.

At first the larvae of this species were confused with those of *A. annulipes* Walk. and the adult with that of *A. amictus* Edw. When, however, the larva-adult correlation was established it was obvious that a distinct species, which one of us was able to identify from the literature as *A. meraukensis*, was involved.

Further study revealed the prevalence and distribution of this species in northern Australia and also threw further light on its differential characters and variability.

Venhuis considered the following to be the important characters of the few specimens he was able to examine:

"1. The dorsum of the abdomen is covered with golden scales as in *A. amictus*.
2. The antennae are unusually broad at the base, as is the case in *A. amictus* but there are white scales on only one segment while in *A. amictus* there are white scales on the first nine segments.
3. Tarsi II to V inclusive of the hind leg have no basal rings as is the case in *A. amictus*."

The first character we have found constant. The second may be confusing as white scales may be present on segments beyond the first flagellar segment of the antennae in *A. meraukensis*, although when this is so, they are smaller and less conspicuous. The

* In "Keys to the Anopheline Mosquitoes of the World", published by the American Entomological Society, 1943, p. 140, Russell, P. F., Rozeboom, L. E., and Stone, A., have cited Venhuis' variety as a subspecies, without comment.

third character does serve to distinguish *A. meraukensis* from the form of *A. amictus* found in Merauke but would not distinguish *A. meraukensis* from *A. amictus* Edw. (*sens. str.*), a form which so far has been recorded only from the mainland of Australia.

Beyond these characters, we have found that *A. meraukensis* is readily distinguishable from all forms of *A. amictus* on the distribution of the pale scaling of the abdominal sternites. In *A. amictus* these pale scales are abundant on the mid-ventral line, and, on the more distal segments (IV-VII) are, to some extent, grouped in lateral patches but the boundaries are ill-defined. In *A. meraukensis* the ventral abdominal scaling is characteristically in the form of small rounded lateral patches of pale scales on segments II-VII.

A further outstanding distinction is found in the prosternum. In *A. meraukensis* this is flat anteriorly and bears one to three strong bristles; in *A. amictus*, on the other hand, this structure has an elongated boss carrying 10–14 hairs and a variable number of broad white scales.

Distribution.—*A. meraukensis* has now been recorded from many places in the Northern Territory extending from near Darwin to Larrimah on the North-South Road and eastward to Groote Eylandt; and also from the Cairns-Townsville area on coastal Queensland.

Northern Territory: Adelaide R., iii.43, iv.43, v.43; Larrimah, iv.43; Blackfellow's Cr., Reynold's R., xi.42 (A.R.W.); Batchelor, iv.43 (Powell); Wynellie, x.43; Oenpelli, v.43; Daly R., v.43; Katherine, Roper Bar, vi.43; Roper R. Mission, vi.43 (A.R.W.); Groote Eylandt, ix.43 (J. Henry). Queensland: Cairns, vii.42 (A.R.W.); Townsville, vii.43 (G. Pasfield); Mareeba, viii.43 (D. Cameron).

Representative specimens have been deposited in the Museum of the Council for Scientific and Industrial Research, Division of Economic Entomology, Canberra, A.C.T.

Note: As the original description of *A. meraukensis* is in Dutch and not readily accessible, we present in Appendix A a full translation of Venhuis' description.

Anopheles novaguinensis Venhuis.

New Synonymy.

(i). *A. punctulatus* var. *novaguinensis* Venhuis, 1933, *Geneesk. Tijdschr. Ned.-Ind.*, lxxiii, 203. Soesilo, R., and van Hell, J. C., 1933, loc. cit., 207.

(ii). *A. derricki* Taylor, 1943, Proc. Linn. Soc. N.S.W., lxviii, 155 (*partim*, female only). *Type locality*: Irvinebank, Queensland.

(iii). *A. breinli* Taylor, 1943, loc. cit., 156. *Type locality*: Irvinebank, Queensland.

Type locality: The middle tract of the Merauke River, Dutch New Guinea, between the compound Kakajoe and Donggeap. Type larva, female and male adults in Section for Malaria Control of the D.V.G. at Batavia-Centrum.

Although this species was originally described as a variety of *A. punctulatus* by Venhuis we have concluded that the form, in our interpretation, is remarkably distinct from other Australian species, including *A. punctulatus*, and hence is best considered as a separate species. The particular reasons for this decision are made clear below.

(i). *A. novaguinensis* in Australia.

Specimens collected in the Northern Territory, because of their very dark appearance, suggested the possibility of *A. novaguinensis*; then, when larvae were obtained which closely resembled the description of the larva of this species and were correlated with these adults, a tentative determination was made of the Northern Territory form as *A. novaguinensis*.

Later examination of a large number of larval and adult specimens revealed that while this common Northern Territory species agreed in all respects with the original description, certain characters varied far more than was indicated originally. The feature which makes the adult of this species so distinct from any other Australasian form is the white scaling of the mesonotum which is restricted to a central longitudinal strip covering about half the width of the mesonotum, leaving the lateral areas bare of scales. As only a very limited series of bred specimens was available for the original description it seems highly probable that this character was overlooked by Venhuis.

The feature which was found more variable than the description suggested was the palpal ornamentation, particularly that of the fourth segment, which we found to vary from completely black to almost two-thirds white in the progeny of a single female of the species.

It should be noted, too, that in the pro-, meso- and meta-pleural hair tufts of the larva, one of the long hairs of each tuft is distinctly branched. This branching is described by Soesilo and van Hell but the Australian specimens frequently exhibit it more clearly than indicated by their figure.

It is of considerable interest to note that Hill (1925)* figures as a variation of *A. punctulatus* var. *moluccensis* a wing which undoubtedly correctly belongs to *A. novaguinensis*. The locality from which the specimen studied by Hill was obtained is doubtful but is most likely either the Northern Territory or New Britain. In any case this is without question the first known record of this distinct species.

Distribution.—A. novaguinensis has been found commonly in the Northern Territory from Darwin to Pine Creek and in certain other isolated localities. It is also recorded from Irvinebank, north Queensland, by Taylor under the names *A. derricki* and *A. breinli* (see below). Recently it has been found at Jacky Jacky, north Queensland, xi.43 (F. Chippendale).

Northern Territory: Adelaide R., ii.43, iii.43 (A.R.W.); Pine Creek, iii.43 (Hegener); 38 m. S. of Darwin, iii.43 (Wilde); Larrakia, iii.43 (N. Johnson); Roper R. Mission, vi.43 (A.R.W.); Port Keats, vi.43 (Fox).

Representative specimens have been deposited in the Museum of the Council for Scientific and Industrial Research, Division of Economic Entomology, Canberra, A.C.T.

Note: For a full translation of Venhuis' original description of *A. punctulatus* var. *novaguinensis* see Appendix B.

(ii). *Anopheles derricki* Taylor (*partim*, type ♀ only).

For reasons detailed above, we have identified a common Northern Territory Anopheline as *A. novaguinensis* Venhuis. The most striking characters in our interpretation of this species are the thoracic scaling and the wing pattern. The mesonotal character is described above and we find that in this respect the type female of *A. derricki* agrees fully with our description. Furthermore, in *A. novaguinensis* the wing is considerably darker than in other Myzomyias and the most striking feature of this is the long, uninterrupted line of black scales on the media instead of the spotting of alternating black and white patches common to other species. In this respect also the type of *A. derricki* agrees both with the original description and with the Northern Territory specimens of *A. novaguinensis*. The completely black fourth palpal segment described by Taylor is admittedly at variance with Venhuis' description, but, as noted above, this is an observed variation in the species. It is logical, therefore, to synonymize the name *A. derricki*, in so far as the description of the female is concerned, with *A. novaguinensis*.

(iii). *Anopheles breinli* Taylor.

Examination of the type of this name revealed that the lateral margins of the mesonotum were bare of scales and in all other respects as well, particularly wings and palpi, this specimen is to be identified with *A. novaguinensis* and the name thus becomes a synonym of that species.

ANOPHELES ANNULIPES Walker.

New Synonymy:

(i). *A. perplexus* Taylor, 1943, PROC. LINN. SOC. N.S.W., lxviii, 153. *Type locality*: Not stated.

(ii). *A. perplexus* var. *persimilis* Taylor, 1943, loc. cit., 155. Type locality: Irvinebank, Queensland.

(iii). *A. derricki* Taylor, 1943, loc. cit., 155 (*partim*, male only). *Type locality*: Irvinebank, Queensland.

* Hill, G. F., 1925, *Proc. Roy. Soc. Vict.*, xxxvii, plate vi, fig. 6*b*.

(i). *Anopheles perplexus* Taylor.

We have examined the holotype and allotype of this name and find them to be identical with *Anopheles annulipes* Walk.; the name *A. perplexus* is, hence, a synonym of *A. annulipes*. The evidence on which this conclusion is based is as follows:

(*a*). The only feature which might appear to separate *A. perplexus* from *A. annulipes* is the presence of scaling on the abdominal tergites, but an examination of a large number of specimens of *A. annulipes* (800 at least) has convinced us that in this species any amount of abdominal scaling may be present between the following extremes: (i) Scales only on tergites VI and VIII and on sternite VIII, and (ii) dense scales on tergites II to VIII and some scales on sternites V to VIII. (This latter extreme is that which occurs in the type of *A. perplexus*.) Further, one of us (A.R.W.) has bred these densely-scaled forms in the Northern Territory (the type locality of *A. perplexus*) and found that the larvae of this form are identical with those of *A. annulipes*. Furthermore, both typical *A. annulipes* and the *A. perplexus* variant have been bred from the same breeding site. This observation has some significance in view of the fact that populations of restricted breeding sites frequently conform to a particular morphological form.

(*b*). Certain features of the description might cause doubt in the minds of workers having to rely on the text and figures alone for an interpretation of the status of *A. perplexus*. In the verbal description it is stated that there is a small patch of flat white scales on the metathorax. It would be unusual if this were so, but actually in the type such scales are not present. The figure of the female palpi does not indicate the presence of a median internal dorsal patch of white scales on the second palpal segment, but as in typical *A. annulipes*, these do occur in the type of *A. perplexus*. The male palp as illustrated appears to have complete white rings in the centres of the second and third segments, but an examination of the allotype showed that these segments are normally ornamented with irregular white scaling dorsally which is not continuous in a ring beneath the palpus.

(ii). *Anopheles perplexus* var. *persimilis* Taylor.

This variety is stated to differ from the typical form in the marking of the palpi and the wings.

Examination of the type revealed that the palpi are identical with those of *A. perplexus* (as illustrated in Fig. 3*a*, but not as described in the text).

The wing is rather darker on the costal margin than is common in *A. annulipes* but nevertheless falls within the range of variation found in this species. The lack of a black spot at the base of the radius is typical of *A. annulipes* and hence this new variety must also be relegated to synonymy with *A. annulipes*.

(iii). *Anopheles derricki* Taylor (*partim*, allotype ♂ only).

The synonymy of this name is somewhat more complex since two species have been confused in the type series of one male and one female specimens. The holotype female is identical with our interpretation of the species *A. novaguinensis* Venhuis and the allotype male is the ubiquitous Australian *A. annulipes*.

No detailed description of the allotype male is given by Taylor apart from figures of the terminalia and palpus. The specimen differs from the type female in two major characters. First, the mesonotum is completely clothed with white curved scales instead of having the lateral margins bare as in the female. Secondly, the wing markings are very distinct from those of the holotype, particularly the media which bears an alternating series of black and white scales as in the wing illustrated (Fig. 4*c*). These characters suffice to show that the male specimen is not identical with the female, and all other features of the male are typical of *A. annulipes* and we must thus record *A. derricki* (in part, male) as synonymous with *A. annulipes* Walk.

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Appendix A.

Anopheles mcraukensis Venhuis 1932. Translation of original description. *Geneesk. Tijdschr. Ned.-Ind.*, lxxii, 1040-42.

Description of Larva.

"Length: 5·5 mm. Colour: dark brown to black, the head especially being very dark. Laterally the thorax is much paler, so that the larva appears very slender, just as in *A. bancrofti* and often in *A. amictus*. Pale areas are present on the first thoracic segment and on abdominal segments III and VIII, sometimes also on segment V. The pale areas are not very distinct.

Head. "Antennae: At about one-third of the length there is a small unbranched lateral hair. The tip hair is divided into 2-4 branches at half its length.

"Clypeus. Inner clypeal hairs: these are far apart and have lateral hairs on the upper half, of which the lowest ones are mostly coarse and are themselves laterally haired. Outer clypeal hairs: these stand some distance back and are very strongly branched. The short stem usually divides into two or three branches, which form together about 30 to 35 stiff straight branches. Posterior clypeal hairs: these are situated not quite so far back as the distance apart of the inner clypeal hairs, and are situated a little inside the outer clypeal hairs. They have six or seven branches. Frontal hairs: nothing particular. Inner hairs with two or three branches, rarely simple. Outer hairs situated definitely to the front, with four or five branches.

Thorax. "Shoulder hairs: the strongly branched centre and inner shoulder hairs have heavy roots which are deformed. The unbranched outer hair is not planted on the root of the centre hair. Fans: on the third thoracic segment a pair of rudimentary fans, sometimes hard to see, with about twelve leaves.

Abdomen. "On the first abdominal segment a small rudimentary fan with about six small leaves. On the remaining segments are well-developed fans with 20-24 leaves. Form of the fan leaf: serrate, sometimes dentate, with sharp point without prolongation. Sometimes with pigmented stains. Comb: this resembles very much that of *A. fuliginosus*, as described by Dr. Walch and Dr. Soesilo in the Mededeelingen van den D.V.G. XVIII, 1929, No. 3. It does not resemble the comb of *A. amictus*.

Description of the Female.

Head. "Proboscis: this is completely black. Palpi*: as long as proboscis, wholly covered with broad scales. The first segment is almost dark, only at the top there is a small white ring and in the middle on the inside a few white scales. The second segment is dark at the base for little more than half, in the middle of which field there are a few white scales. The distal half is white. The fourth segment is totally white, with the exception of a very small narrow black ring at the base. Antennae: the basal portion is, just as in *A. amictus*, broader than in other Anophelines, while the antenna has the usual width at the distal portion. The first section only is littered with broad white scales and white hairs, the other sections have hairs only. Head: in front between the eyes are placed long white hairs, behind those are broad white scales, then white forked scales and behind those black forked scales.

Thorax. "Prothoracic lobes: a bundle of broad black scales are present on these and some black hairs. Mesonotum: grey, completely covered with broad white scales; on both sides and behind there are also hairs. Scutellum: some broad white scales and black hairs.

Abdomen. "The first segment shows dorsally some yellow scales and black and yellow hairs. All segments are, just as in *A. amictus*, closely and regularly covered with broad gold-coloured scales; between the scales are yellow and black hairs. Ventrally the first four segments show sparsely scattered yellow and white scales, in between them a fair amount of yellow and black hairs. Further behind, the amount of yellow scales increases, while here the white scales in the middle of the front margin of each segment are united into groups. At the very end are black scales.

Legs. "Femur, tibia and tarsus I of all legs are stained light-yellow, and in addition to this, tarsi II, III, and IV of the hind leg have some light scales in the middle part. Tarsi I to IV inclusive of all legs, have on the apex a yellow band, while there are rings at the base of tarsi II to V inclusive of fore- and mid-leg, these being absent on the hind leg.

Wings. "The top of the first fork cell is clearly closer to the base of the wing than is the top of the second fork cell. Costa: at the base a very small dark stain and two similarly small stains, towards the apex a large stain, which corresponds with a stain on subcosta and first longitudinal vein. Towards the top is a very large stain, corresponding with a stain on subcosta, first and second longitudinal veins, followed up by a big stain, which is opposed by a stain on first longitudinal vein, and very near to the top another big stain opposite a stain on the first longitudinal vein. Subcosta with two large black stains. First longitudinal vein: at base a small stain, then a large stain, and then a stain, not quite so large opposite the very large stain

* First segment is in reality segments I and II together and so second segment in this description is really segment III, third segment is segment IV and fourth segment is segment V.

on costa and subcosta, then again two or three small stains, then a relatively large stain, then a small stain and then at last sub-apically a large stain. Second longitudinal vein: on the stem one large and two small stains; the upper branch of the fork has two groups of three small stains, the lower branch has six disseminated small stains. Third longitudinal vein: seven stains. Fourth longitudinal vein: the stem has six small stains and one large stain just in front of the bifurcation. On both branches of the fork one fairly large and two small stains. Fifth longitudinal vein: on the stem four or five small stains, on both branches of the fork four small stains. Sixth longitudinal vein: 6 to 8 small stains. Fringe: this is dark between the joints of all branches, except between the first longitudinal vein and the upper branch of the second longitudinal vein and except between the lower branch of the second and third longitudinal veins."

Appendix B.

Anopheles punctulatus var. *novaguinensis* Venhuis 1933. Translation of original description. *Geneesk. Tijdschr. Ned.-Ind.*, lxxiii, 203-206.

Description of Larva.

"Length: 5 mm. Colour: dark brown, sometimes more transparent. Spots were not seen on thorax or abdominal segments.

Head. "Antennae: at about one-third the length there is a small unbranched lateral hair. Clypeus: inner clypeal hairs—these are distinctly further apart than they are from the outer clypeal hairs (20-7) and have distinct lateral hairs. Outer clypeal hairs: these are half as long as the inner clypeal hairs (30-60) and have coarse lateral hairs. Posterior clypeal hairs: these are about one-third as long as the inner clypeal hairs (19-60) and have three to five branches. They are situated about their own length behind the inner clypeal hairs, somewhat further apart than these. Occipital hairs: inner occipital hairs two-branched; outer occipital hairs with four to six branches.

Thorax. "Shoulder hairs: the inner and centre hairs have heavy roots which have not grown clearly. The centre hair has about 12-14 lateral branches, the inner hair 10-12 branches. The unbranched outer hair is not planted on the root of the centre hair. Fans: on the third thoracic segment are a pair of rudimentary fans with four to five small leaves.

Abdomen. "On the first abdominal segment is a rudimentary fan with about ten small leaves. On the second a small fan with about 18 leaves. On the remaining segments well-developed fans with about 20 leaves. Form of the fan leaf: serrated with a small point without filament; unpigmented. Pecten: this resembles closely that of *A. fuliginosus* but not that of *A. punctulatus*.

Description of Female Adult.

Head. "Proboscis: this is completely black. Palpi*: the same length as the proboscis. The first segment is almost completely dark, with a narrow white ring at the tip. The second segment is dark for about the basal half, the apical half is completely white. The third segment is dark for about the basal half, the rest white. The fourth segment is quite white except for a narrow dark basal ring. On the dark palpal segments there are no yellow or white scales. Antennae: on the base and the first segment there are some white scales. Head: in front between the eyes there are long white hairs, behind these broad white scales, then wide white fork scales and behind these a very few black fork scales.

Thorax. "On the prothoracic lobes a group of black scales and hairs. Mesonotum brown-grey, covered with white scales and some yellow-brown hairs.

Abdomen. "Only hairs except on the last segment where there are some white scales. On the hypopygium black scales. Ventrally on the abdomen no scales.

Legs. "Femur, tibia, and tarsus I of all legs stained. Tibia, and tarsi I to IV of all legs have very narrow apical white bands. Tarsus V is completely dark. Basal bands are present on none of the legs.

Wings. "The tip of the first fork cell is closer to the wing base than that of the second. The whole wing gives a darker impression than in *A. punctulatus* var. *moluccensis*. Costa: basally two equally small stains, followed by four large stains of which the second is very large. Subcosta: two large stains opposite the first and second large costal stain. First longitudinal vein: four large stains opposite those of the costa. Between the first and second stain there is one small stain, while sometimes the third stain is divided in two. Second longitudinal vein: on the stem two long stains, the bifurcation is pale; on the first branch a long and a short stain, on the second branch two to four small stains completely or almost completely merged. Third longitudinal vein: six small stains, often almost merged. Fourth longitudinal vein: on the stem two long spots, the bifurcation is pale, on the first and the second branch two very large stains. Fifth longitudinal vein: on the stem there follow in succession a small and a large stain, the latter of which usually extends to the second branch. On the first branch four stains, which are sometimes merged two and two together, on the second branch a small and a large stain. Sixth longitudinal vein: four stains of which the last two are long. Fringe: This is dark between the terminations of all veins except between the first longitudinal vein and the first branch of the second longitudinal vein and between the second branch of the second longitudinal vein and the third longitudinal vein. Further there are pale patches at the termination of all veins except those of the sixth longitudinal vein."

* See footnote on page 71.